

A Model of (Counter)Terrorism with Location Choice

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Abstract

We incorporate features of family transfer models into the study of terrorism. Our model allows for interactions among two terrorist groups and the central command they both belong to. Together they plan three attacks—two at the base locations of the groups and a final attack whose location is chosen by the central command. The central command is assumed to be in possession of no “soldiers,” and the two groups decide their resource allocations between own local attack and the final attack. We find their incentives to allocate resources between the attacks to be depending upon whether the two local attacks occur simultaneously or sequentially as well as the relative values the two groups attached to their locations.

Keywords: Terrorism; Location; Simultaneous; Sequential

JEL Classification Numbers: D7; F5; C7

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1 Introduction

Game-theoretic rational-choice models have provided important insights to the analyses of terrorism and counterterrorism.¹ Notable examples include [Sandler et al. \(1983\)](#) and [Bueno de Mesquita \(2005a,b,c\)](#) on various interactions between government and terrorists, [Powell \(2007\)](#) on defending against a strategic terrorist group, [Cadigan and Schmitt \(2010\)](#) on entry deterrence and terrorism, [Bandyopadhyay and Sandler \(2011\)](#) on the interplay between preemptive and defensive measures, [Bandyopadhyay et al. \(2011, 2014\)](#) on the relationship between foreign aid, terrorism, and counterterrorism, and [Das and Chowdhury \(2014\)](#) on deterrence and preemption.

Based on the framework of family transfers ([Buchanan, 1983](#); [Chang and Weisman, 2005](#); [Chang and Luo, 2015](#)), we extend existing literature on the study of terrorism to consider a terrorist central command's choice of a final attack. In our model, three attacks are planned: two local terrorist groups will attack the locations they are based in, and a final location chosen by the central command. The local terrorist groups choose between allocating their resources in local attack or helping the final attack as the central command is assumed to be in possession of no "soldiers." The marginal cost of a local group helping the final attack is in lowering its own gain in the local attack. The marginal benefit, on the other hand, comes from the central command distributing any leftover resource after the final attack to the two groups according to their relative contributions.

Our model considers both simultaneous and sequential moves by the local groups. Two common results arise. First, the final attack is closer to the location with higher marginal transportation cost. Second, local group provides less help to the central command when value of its own location increases. When the two local attacks occur simultaneously, the high-valued location provides more help to the central command when the low-valued location's value increases, while the low-valued location does vice versa. Other things

¹For recent surveys, see [Sandler and Arce \(2003\)](#); [Sandler and Siqueira \(2009\)](#); [Sandler \(2015\)](#); [Schneider et al. \(2015\)](#)

being equal, the overall helps unambiguously decline when either location's intrinsic value increases. When the two local attacks occur sequentially, the first-mover provides more help to the central command when the value of the second-mover's location is higher, while the second-mover provides more help to the central command when its value is lower/higher than the first mover's location and the value of the first-mover's location increases/decreases. Other things being equal, the overall helps unambiguously decline when value of the first-mover's location increases while changes in the value of the second-mover's location have no impact on the size of overall helps.

Interestingly, our model can also be interpreted from the perspectives of counterterrorism. The easier comparison is to think of the game played by two local commanders of counterterrorism forces and the headquarter, with the headquarter choosing a location and needing helps from the local commanders. From the angle of counterterrorism intelligence and planning, one can also think of two counterterrorism ideologies, such as defensive versus proactive ([Sandler, 2015](#)). The chief of counterterrorism, however, is somewhere in between. In such a case, the two campaigns need to determine how to split efforts between collecting intelligence to support its own ideology and helping the chief, while the chief decides the "distance" from the two campaigns.

Models in which terrorists have choice between two or more targets are most relevant to the current study. In a model with two potential targets, [Sandler and Lapan \(1988\)](#) show that the two targets may over-invest in defensive measures because they are interdependent, i.e., the terrorist will attack the more vulnerable target. [Siqueira and Sandler \(2008\)](#) further show that voters can strategically choose a policymaker to mitigate the prisoner's dilemma arisen from the oversupply of defensive counterterrorism measures. The chosen policymaker has a different preference from the voters. In a recent contribution, [Hausken \(2012\)](#) shows that to a terrorist without capacity constraints, targets are no longer interdependent. In a model with multiple targets, [Bier et al. \(2007\)](#) show results similar to the aforementioned studies, i.e., negative externalities among locations. They also show an interesting result that

the defender may optimally leave a location undefended.

The rest of the paper is organized as follows. The next section outlines model setup while also solves central command's location choice. Section 3 and 4 discuss results from the simultaneous and sequential moves games, respectively. Comparison between the two settings are considered in Section 5. The last section concludes.

2 The Model

We study a game with three players: the central command of a terrorist organization and leaders of two terrorist groups at different locations supporting the organization. We label the local groups/leaders by $i(= 1, 2)$. A total of three attacks are planned: one at each location, and a final attack pending its location chosen by the central command in the last stage of the game. The central command is assumed to be in possession of no "soldiers." As a result, the final attack must be helped with personnels from the two groups. We consider the possibilities of simultaneous and sequential attacks. In the latter case, without loss of generality, we assume group 1 attacks first. When the two groups attack simultaneously, the game consists of two stages. When the two groups attack sequentially, the game consists of three stages.

The leader of each local group is assumed to be endowed with 1 unit of resource, which may be allocated between local attack or helping central command in the final attack. Let A_i denote the fraction of resource allocated to the final attack by group i . Furthermore, assume location i has an intrinsic value of w_i to the terrorist group. The expected payoff from the local attack can then be written as $(1 - A_i)w_i$, in which $(1 - A_i)$ may be considered the probability of a successful local attack at location i .

The central command of the terrorist organization is assumed to be endowed with a fixed amount of resources denoted by M and makes a location choice for the final attack in the last period of the game. Without loss of generality, we assume total distance between

the two locations to be 1 and the final attack occurs on the line that connects the two locations. Let d_1 denote the distance between the location of the final attack and group 1, then distance from group 2 is $d_2 = 1 - d_1$. Once the location of the final attack is chosen, the central command pays all costs of transporting personnels from the two locations. We assume the costs of commuting from i to the final location to be $\beta_i d_i^2$, which is marginally increasing in distance. After all transportation costs are paid for, the leftover resources, in the amount of $M - \beta_1 d_1^2 - \beta_2 d_2^2$, is dispensed to the local groups according to their relative contributions in helping the final attack. The share received by group i is $\frac{A_i}{A_1 + A_2}$. As a result, $\frac{A_i}{A_1 + A_2}(M - \beta_1 d_1^2 - \beta_2 d_2^2)$ is leader i 's payoff from helping the central command. Let Y_i denote leader i 's expected utility, according to the above discussion, we have

$$Y_i = (1 - A_i)w_i + \frac{A_i}{A_1 + A_2}(M - \beta_1 d_1^2 - \beta_2 d_2^2). \quad (1)$$

On the other hand, the central command is assumed to care about total helps received from the two groups in the final attack, $A_1 + A_2$, as well as the expected utilities of the two groups, $Y_1 + Y_2$. As a result, the central command's expected utility is specified as

$$U = \gamma(Y_1 + Y_2) + \alpha(A_1 + A_2), \quad (2)$$

where A_i and Y_i are as defined before, and γ and α are marginal utilities from the two components, respectively.

The game is solved using backward induction beginning with the central command's maximization problem. After substituting Equation (1) and the condition $d_1 + d_2 = 1$ into Equation (2), the first order condition (FOC) of the central command's expected utility maximization problem is given by

$$\frac{\partial U}{\partial d_1} = 2\gamma(\beta_2 - \beta_1 d_1 - \beta_2 d_1) = 0, \quad (3)$$

which implies the solution

$$d_1 = \frac{\beta_2}{\beta_1 + \beta_2}. \quad (4)$$

The solution of d_1 is a function of only β_1 and β_2 , the parameters that govern the marginal transportation costs between the two groups and the location of the final attack. The solution indicates that central command will be located closer to the location with higher marginal transportation cost.

3 Simultaneous Moves

From Equation (1), we find leaders' FOCs as

$$\frac{\partial Y_1}{\partial A_1} = -w_1 + \frac{A_2}{(A_1 + A_2)^2} (M - \beta_1 d_1^2 - \beta_2 d_2^2) = 0; \quad (5a)$$

$$\frac{\partial Y_2}{\partial A_2} = -w_2 + \frac{A_1}{(A_1 + A_2)^2} (M - \beta_1 d_1^2 - \beta_2 d_2^2) = 0. \quad (5b)$$

Let \bar{A}_i denote the solution to leader i 's expected utility maximization problem with simultaneous move. Solving for A_1 and A_2 from Equations (5), after substituting in Equation (4), gives

$$\bar{A}_i = \frac{w_j (M(\beta_1 + \beta_2) - \beta_1 \beta_2)}{(w_1 + w_2)^2 (\beta_1 + \beta_2)}. \quad (6)$$

To ensure \bar{A}_i is positive, the condition $M > \frac{\beta_1 \beta_2}{\beta_1 + \beta_2}$ is assumed throughout the paper. The following comparative statics can be derived from Equation (6):

$$\frac{\partial \bar{A}_i}{\partial w_i} < 0; \quad \frac{\partial \bar{A}_i}{\partial \beta_i} < 0; \quad \frac{\partial \bar{A}_i}{\partial \beta_j} < 0; \quad \frac{\partial \bar{A}_i}{\partial M} > 0.$$

These comparative statics allow us to establish the following proposition

Proposition 1. *The help provided by a local group to the central command is higher when the location's value (w_i) is lower, the marginal transportation costs (β_1 and β_2) are lower, and the overall resources held by the central command (M) are higher.*

In addition, we find

$$\frac{\partial \bar{A}_i}{\partial w_j} = \frac{(w_i - w_j)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(w_1 + w_2)^3(\beta_1 + \beta_2)},$$

which is positive if and only if $w_i > w_j$. In other word, the group at the higher-valued location allocates more resources in helping the central command when the value of the other location increases. This result arises because leader at the low-valued location allocates less resources in helping the central command when its own value increases ($\frac{\partial \bar{A}_i}{\partial w_i} < 0$). For the high-valued location, the marginal benefit of helping central command (in receiving more transfers) outweighs the marginal benefit of its own attack.

Another interesting question remains: other things being equal, what happens to total helps provided to the central command from the two groups combined when a location's value changes? It can be calculated that

$$\frac{\partial \bar{A}_i}{\partial w_i} + \frac{\partial \bar{A}_j}{\partial w_i} = -\frac{(w_i + w_j)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(w_1 + w_2)^3(\beta_1 + \beta_2)} < 0,$$

which implies a overall decline in helps received by the central command. These results lead to the following proposition

Proposition 2. *Other things being equal, when the value of the high/low-valued location increases, the other group decreases/increases its help to the central command. However, the overall helps unambiguously decline when a location's intrinsic value increases.*

Plugging Equations (4) and (6) into Equations (1) and (2) gives the expected utilities of group i and the central command in the simultaneous game as

$$\bar{Y}_i = w_i + \frac{w_j^2(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(w_1 + w_2)^2(\beta_1 + \beta_2)}; \quad (7)$$

$$\bar{U} = (w_1 + w_2)\gamma + ((w_1^2 + w_2^2)\gamma + (w_1 + w_2)\alpha) \frac{(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(w_1 + w_2)^2(\beta_1 + \beta_2)}. \quad (8)$$

It is straightforward to verify the following results:

$$\frac{\partial \bar{Y}_i}{\partial M} > 0; \quad \frac{\partial \bar{Y}_i}{\partial \beta_i} < 0; \quad \frac{\partial \bar{Y}_i}{\partial \beta_j} < 0; \quad \frac{\partial \bar{U}}{\partial M} > 0; \quad \frac{\partial \bar{U}}{\partial \beta_i} < 0; \quad \frac{\partial \bar{U}}{\partial \gamma} > 0; \quad \frac{\partial \bar{U}}{\partial \alpha} > 0.$$

In addition, we have

$$\begin{aligned} \frac{\partial \bar{Y}_i}{\partial w_i} &= 1 - \frac{2w_j^2(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(w_1 + w_2)^3(\beta_1 + \beta_2)} = 1 - \left(\frac{2w_j}{w_1 + w_2} \right) \bar{A}_i; \\ \frac{\partial \bar{Y}_i}{\partial w_j} &= \frac{2w_1w_2(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(w_1 + w_2)^3(\beta_1 + \beta_2)} > 0; \\ \frac{\partial \bar{U}}{\partial w_i} &= \gamma \left(1 - \frac{2w_j(w_j - w_i)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(w_1 + w_2)^3(\beta_1 + \beta_2)} \right) - \frac{(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(w_1 + w_2)^2(\beta_1 + \beta_2)} \alpha \\ &= \gamma \left(1 - \frac{2(w_j - w_i)}{(w_1 + w_2)} \bar{A}_i \right) - \frac{(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(w_1 + w_2)^2(\beta_1 + \beta_2)} \alpha; \end{aligned}$$

It can be verified that $\frac{\partial \bar{Y}_i}{\partial w_i} > 0$ if $w_j < w_i$, and $\frac{\partial \bar{U}}{\partial w_i} < 0$ if $w_j > w_i$.² The above results allow us to establish the following proposition

Proposition 3. *All players have higher expected utility when the marginal transportation costs (β_1 and β_2) are lower and the overall resources held by the central command (M) are higher. For the high-valued location, expected utility is higher when value of either location is higher. For the low-valued location, expected utility is higher when value of the other locale is higher. For the central command, expected utility is higher when the low-valued location's value is lower.*

4 Sequential Moves

When the two local leaders move sequentially, without loss of generality, we assume leader 1 to be the first mover. Let \tilde{A}_i denote the solution to the leaders' expected utility

²The comparative statics we are unable to sign unambiguously are $\frac{\partial \bar{Y}_i}{\partial w_i}$ for the low-valued location and $\frac{\partial \bar{U}}{\partial w_i}$ for the high-valued location.

maximization problem with sequential moves. Solving for A_2 from Equation (5b), we get

$$\tilde{A}_2 = \frac{\sqrt{w_2 A_1 (M - \beta_1 d_1^2 - \beta_2 d_2^2)}}{w_1} - A_1 \quad (9)$$

Substituting Equation (9) into (1), the FOC for leader 1 is given by

$$\frac{\partial Y_1}{\partial A_1} = \frac{\sqrt{w_2 A_1 (M - \beta_1 d_1^2 - \beta_2 d_2^2)}}{2A_1} - w_1,$$

which gives the solution

$$\tilde{A}_1 = \frac{w_2 (M(\beta_1 + \beta_2) - \beta_1 \beta_2)}{4w_1^2 (\beta_1 + \beta_2)}, \quad (10)$$

after substituting in (4). Plugging (10) back to Equation (9) gives the solution to A_2 as

$$\tilde{A}_2 = \frac{(2w_1 - w_2)(M(\beta_1 + \beta_2) - \beta_1 \beta_2)}{4w_1^2 (\beta_1 + \beta_2)}. \quad (11)$$

Equation (11) is positive if and only if $2w_1 > w_2$. In other words, the value from the location that moves first must be greater than half of the value from the location that moves second. Otherwise, the latter has no incentive to provide any help to the central command. Assuming the condition $2w_1 > w_2$ holds in the rest of this paper, we can derive the following comparative statics:

$$\frac{\partial \tilde{A}_1}{\partial w_1} < 0; \quad \frac{\partial \tilde{A}_1}{\partial w_2} > 0; \quad \frac{\partial \tilde{A}_1}{\partial \beta_1} < 0; \quad \frac{\partial \tilde{A}_1}{\partial \beta_2} < 0; \quad \frac{\partial \tilde{A}_1}{\partial M} > 0; \quad \frac{\partial \tilde{A}_2}{\partial w_2} < 0; \quad \frac{\partial \tilde{A}_2}{\partial M} > 0.$$

These results allow us to establish the following proposition

Proposition 4. *The help provided by the local group who moves first (group 1) is higher when the location's value (w_1) is lower, the other location's value (w_2) is higher, the marginal transportation costs (β_1 and β_2) are lower, and the overall resources held by the central command (M) are higher.*

In addition, we have

$$\begin{aligned}\frac{\partial \tilde{A}_2}{\partial w_1} &= \frac{(w_2 - w_1)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{2w_1^3(\beta_1 + \beta_2)}, \\ \frac{\partial \tilde{A}_2}{\partial \beta_1} &= \frac{(w_2 - w_1)\beta_2^2}{4w_1^2(\beta_1 + \beta_2)^2}, \\ \frac{\partial \tilde{A}_2}{\partial \beta_2} &= \frac{(w_2 - w_1)\beta_1^2}{4w_1^2(\beta_1 + \beta_2)^2}.\end{aligned}$$

The following proposition summarizes these results

Proposition 5. *The help provided by the local group who moves second (group 2) is higher when the location's value (w_2) is lower and the overall resources held by the central command (M) are higher. When the value of the second mover is lower/higher than the first mover, the help provided by group 2 is higher when the other location's value (w_1) is higher/lower and the marginal transportation costs (β_1 and β_2) are lower/higher.*

Similar to the case of simultaneous move, we examine how changes in values of the two locations will affect the overall helps received by the central command. We find that

$$\frac{\partial \tilde{A}_1}{\partial w_1} + \frac{\partial \tilde{A}_2}{\partial w_1} = -\frac{w_1(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{2w_1^3(\beta_1 + \beta_2)} < 0; \quad \frac{\partial \tilde{A}_1}{\partial w_2} + \frac{\partial \tilde{A}_2}{\partial w_2} = 0.$$

These results lead to the following proposition

Proposition 6. *Other things being equal, total helps provided to the central command decreases/increases when the value of the location that moves first increases/decreases. When there is a change of value in the location that moves second, total helps provided to the central command remains unchanged.*

Plugging Equations (4), (10), and (11) into Equations (1) and (2) gives the expected

utilities of local leader i and the central command in the sequential game as

$$\tilde{Y}_1 = w_1 + \frac{w_2(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1(\beta_1 + \beta_2)}; \quad (12)$$

$$\tilde{Y}_2 = w_2 + \frac{(2w_1 - w_2)^2(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1^2(\beta_1 + \beta_2)}; \quad (13)$$

$$\tilde{U} = (w_1 + w_2)\gamma + ((4w_1^2 + w_2^2 - 3w_1w_2)\gamma + 2w_1\alpha) \frac{(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1^2(\beta_1 + \beta_2)}. \quad (14)$$

It is straightforward to verify the following results:

$$\frac{\partial \tilde{Y}_i}{\partial M} > 0; \quad \frac{\partial \tilde{Y}_i}{\partial \beta_i} < 0; \quad \frac{\partial \tilde{Y}_i}{\partial \beta_j} < 0; \quad \frac{\partial \tilde{U}}{\partial M} > 0; \quad \frac{\partial \tilde{U}}{\partial \beta_i} < 0; \quad \frac{\partial \tilde{U}}{\partial \gamma} > 0; \quad \frac{\partial \tilde{U}}{\partial \alpha} > 0.$$

In addition, we have

$$\begin{aligned} \frac{\partial \tilde{Y}_1}{\partial w_1} &= 1 - \frac{w_2(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1^2(\beta_1 + \beta_2)} = 1 - \tilde{A}_1 > 0; \\ \frac{\partial \tilde{Y}_1}{\partial w_2} &= \frac{(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1(\beta_1 + \beta_2)} > 0; \\ \frac{\partial \tilde{Y}_2}{\partial w_1} &= \frac{w_2(2w_1 - w_2)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{2w_1^3(\beta_1 + \beta_2)} > 0; \\ \frac{\partial \tilde{Y}_2}{\partial w_2} &= 1 - \frac{2(2w_1 - w_2)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1^2(\beta_1 + \beta_2)} = 1 - 2\tilde{A}_2; \\ \frac{\partial \tilde{U}}{\partial w_1} &= \gamma + (2w_1\alpha - w_2(3w_1 - 2w_2)\gamma) \frac{(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1^3(\beta_1 + \beta_2)}; \\ \frac{\partial \tilde{U}}{\partial w_2} &= \left[1 - \frac{(3w_1 - 2w_2)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1^2(\beta_1 + \beta_2)} \right] \gamma; \end{aligned}$$

It can be verified that $\frac{\partial \tilde{U}}{\partial w_1} > 0$ and $\frac{\partial \tilde{U}}{\partial w_2} > 0$ if $w_1 < \frac{2}{3}w_2$. The above analysis allow us to establish the following proposition

Proposition 7. *All players have higher expected utility when the marginal transportation costs (β_1 and β_2) are lower and the overall resources held by the central command (M) are higher. For the first mover, expected utility is higher if value of either location is higher. For the second mover, expected utility is higher when value of the first mover is higher. When*

$w_1 < \frac{2}{3}w_2$ holds, central command's expected utility is higher when value of either location is higher.

5 Simultaneous versus Sequential

From Equations (6), (10), and (11), we find

$$\begin{aligned}\bar{A}_1 - \tilde{A}_1 &= \frac{w_2(3w_1 + w_2)(w_1 - w_2)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1^2(w_1 + w_2)^2(\beta_1 + \beta_2)}; \\ \bar{A}_2 - \tilde{A}_2 &= \frac{(2w_1 + w_2)(w_1 - w_2)^2(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{4w_1^2(\beta_1 + \beta_2)} > 0; \\ (\bar{A}_1 + \bar{A}_2) - (\tilde{A}_1 + \tilde{A}_2) &= \frac{(w_1 - w_2)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{2w_1(w_1 + w_2)(\beta_1 + \beta_2)}.\end{aligned}$$

It is straightforward to verify that $\bar{A}_1 > \tilde{A}_1$ and $(\bar{A}_1 + \bar{A}_2) > (\tilde{A}_1 + \tilde{A}_2)$ if and only if $w_1 > w_2$. Furthermore, we calculate the expected utilities and find

$$\begin{aligned}\bar{Y}_1 - \tilde{Y}_1 &= \left(\frac{w_2}{(w_1 + w_2)^2} - \frac{1}{4w_1} \right) \frac{w_2(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(\beta_1 + \beta_2)} < 0 \\ \bar{Y}_2 - \tilde{Y}_2 &= \left(\frac{w_2(w_2 - w_1)(4w_1^2 - w_2^2 + w_1w_2)}{4w_1^2(w_1 + w_2^2)} \right) \frac{(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{(\beta_1 + \beta_2)} \\ \bar{U} - \tilde{U} &= \left[\alpha - \frac{w_2(5w_1^2 - w_2^2)}{2w_1(w_1 + w_2)} \gamma \right] \frac{(w_1 - w_2)(M(\beta_1 + \beta_2) - \beta_1\beta_2)}{2w_1(w_1 + w_2)(\beta_1 + \beta_2)}\end{aligned}$$

It can be verified that $\bar{Y}_2 - \tilde{Y}_2 > 0$ if and only if $w_2 > w_1$. In addition, $\bar{U} - \tilde{U} < 0$ if $w_1 < \frac{w_2}{\sqrt{5}}$. These results allow us to establish the following proposition:

Proposition 8. *When values of the two locations are different, the second mover provides more help to the central command in the simultaneous game than in the sequential game, while the first mover's expected utility is always higher in the sequential game. When value of the first mover is lower/higher than the second mover, the first mover provides less/more help to the central command in the simultaneous game than in the sequential game and the overall helps are also less/more. In addition, the second mover's expected utility is higher/lower in*

the simultaneous game than in the sequential game. If the first mover's value is much lower than the second mover, that is, $w_1 < \frac{w_2}{\sqrt{5}}$, the central command's expected utility is lower in the simultaneous game than in the sequential game.

6 Discussion and Conclusion

Work in progress.

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